Impact of Bunna (Ethiopian coffee preparation) Consumption on Type 2 Diabetes Mellitus

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Abstract

Coffee is one of the most widely consumed beverages in the world. Coffee, in its beverage form, is a complex chemical mixture especially after the roasting process. Mainly as a result of the generation of compounds deriving from the Maillard reaction, the roasting process leads to substantial changes in the chemical composition and biological activities of coffee. In Ethiopia, medium roasted coffee is the most widely used. Generally, coffee is consumed for its stimulatory effects as it is rich in Caffeine. Besides Caffeine, coffee contains lot of bioactive components like chlorogenic acid, caffeic acid, Hydroxyhydro quinine, Lignans etc. which act as potent antioxidants and are involved in health improving activity. Though many epidemiological studies found that coffee drinking is associated with a lower risk of Type 2 Diabetes Mellitus (T2DM), Caffeine present in the Coffee, impairs insulin sensitivity and glucose tolerance. So, controversy still persists whether coffee is beneficial or troublesome for Type 2 Diabetes Mellitus. We studied the influence of moderate Bunna (Ethiopian coffee preparation) consumption (6 – 8 cups/ Day) on Type 2 DM in a sample of 60 healthy adult Type 2 DM populations associated with physical activity or sedentary life style. The present study reveals that moderate Bunna intake is favourably associated to control Type 2 Diabetes Mellitus in the population involved in moderate physical activity.

Key words: Bunna (Coffee) consumption, Type 2 Diabetes Mellitus, Physical activity.

1. Introduction

Beverages have an important role in our daily diet and they are categorized into two major classes, namely non-alcoholics and alcoholics.
A number of varieties are available among non- alcoholic beverages including tea, coffee, carbonated beverages, fruit juices etc. However, coffee holds second position in consumption among beverages after water and people from all over the world consume approximately 500 billion cups annually [1]-[3].

Presently after petroleum it has become the second largest traded commodity worldwide and it is involved in business of 10 billion US Dollar annually [1]. More than 70 countries cultivate this plant but Brazil, Colombia, Mexico, Ethiopia and India are the leading producers. Production in Africa is the highest of any continent, amounting to 70% of world population [4].

Coffee, in its beverage form , is a complex chemical mixture especially after the roasting process[5] but it is rich in of antioxidants like chlorogenic acid(3-3,4-Dihydroxy-cinnamoyl quinic acid), caffeic acid(3,4-Dihydroconnamic acid), hydroxyhydro quinone(1,2,4-Trihydroxy benzene), lignans, trigonelline and these compounds play an important role in the health profile of the consumers by protecting the body from the hazardous effects of the free radicals and significantly improved insulin sensitivity or glucose levels in animal and human studies[6]-[8].

Most of the epidemiological studies reported that coffee consumption is associated with a substantially lower risk of type 2 diabetes mellitus (T2DM)[9]-[13].

On the otherhand, it is well documented that the ingestion of caffeine or caffeinated coffee actually deteriorates glucose tolerance as assessed by postprandial plasma glucose concentrations. [14]-[18]. So, debate still persists whether coffee is beneficial or troublesome for T2DM.Again, T2DM is one of the leading cause of death in the world [19]-[20].

The number of T2DM patients has dramatically increased especially in the developing countries like, Ethiopia, India [21].The International Diabetes Federation estimated that the diabetes population will reach 380 million globally by 2025[20].

As the consumption of coffee is increasing all over the globe and its scale is on the rise in developing economies especially in Ethiopia. So, we have evaluated the role of Bunna (Ethiopian coffee preparation) consumption, life style pattern and its impact on the T2DM in this study.

5. Research Design and Methods

Sixty (60) healthy adult type 2 Diabetic Ethiopian subjects, aged 30 – 65, dependent on oral hypoglycemic medications were chosen from Aksum town for this study. After discussion with the subjects about their life style pattern, all subjects were divided into 3 groups. Group 1 was comprised of 20 diabetic subjects with sedentary life style. Group 2 was comprised of 20 diabetic subjects with involved in daily moderate physical activity. Group 3 was also comprised of 20 diabetic subjects with involved in daily physical activity.
Participants of Group 1 and Group 2 were told to consume moderate amount of Bunna (Ethiopian coffee preparation) 6 – 8 cups / day and to maintain their respective life style for 8 weeks. Participants of Group 3 were told not to take Bunna or other caffeinated beverages but to maintain daily moderate physical activity for 8 weeks.

Fasting (12hr.) blood glucose of each participant was measured by Instant Glucometer (Made in Germany), before and after (8 weeks) study period.
This study design was approved by the Ethics Committee of the Medical College and each participant gave written informed consent.
Study was conducted in the period of March- April, 2015.

Bunna Preparation: After washing the green coffee beans with water, it was roasted until the beans were blackened, grinded to make coarse powder and boiled in water and served without filtration.
Sugar, milk or any other additives were not added in the Bunna.

Definition of Type 2 Diabetes: Type 2 Diabetes (T2DM) was defined as a fasting plasma glucose concentration 126 mg / dl.

Data Analysis: Data are presented as means and SD unless otherwise indicated. Data were analyzed using student's t test. P values 0.05 were interpreted as statistically significant.

5. Results and Discussion

Table I shows the baseline characteristics of 3 groups of T2DM subjects about gender, age, height and weight. Data shows that there were no significant differences in the characteristics among 3 groups of T2DM subjects.
Table II shows that fasting blood sugar (FBS) of Group 1 T2DM subjects having sedentary lifestyle was not significantly reduced after consuming bunna for 8 weeks.

But FBS of Group 2 T2DM subjects involved in moderate physical activity was significantly reduced after consuming bunna for 8 weeks. On the other hand, FBS of Group 3 T2DM subjects who were involved in physical activity since before the experimental period, was not significantly changed after 8 weeks without consumption bunna.

Several mechanisms have been proposed to explain the association between coffee consumption and T2DM. Magnesium is a component of coffee, and a higher magnesium intake from food can improve insulin resistance, glycemic control and reduce the risk of T2DM [22]-[23].

Coffee can stimulate thermogenesis and increase energy expenditure, which could result in weight reduction [11]. Coffee contains anti-oxidants, which promote insulin sensitivity, thus preventing or delaying the development of T2DM [24].

The contents of coffee such as chlorogenic acid, quinic acid, trigonelline, and lignin secoisolariciresinol have been reported to improve glucose metabolism [24]-[26].

Coffee consumption may improve subclinical inflammation which represents a potential link between coffee and diabetes risk. Recent intervention trial demonstrated favourable effects of coffee on inflammatory markers in clinical trials [27].

Previous studies of Chlorogenic acid (CGA), the second abundant component in coffee after caffeine, showed its ability to delay intestinal glucose absorption and inhibit hepatic glucose output [28]-[31].

CGA was shown to stimulate and enhance both basal and insulin-mediated glucose transports and thus augmenting glucose utilization in the muscle. Addictive effect of CGA in insulin-mediated glucose transport suggests that CGA may act through a significant pathway which is different from insulin signaling. The effect of CGA on glucose transport may possibly be mediated by AMP-activated protein kinase (AMPK) [32].

AMPK is a master sensor and regulator of cellular energy balance [33]. It is activated by various pharmacological, pathological and metabolic stressors such as metformin, hypoxia and exercise. Activation of AMPK leads to translocation of GLUT 4 from intracellular membranes to plasma membranes, thus increasing glucose transport [34].

	Group 1	Group 2	Group 3
Male (n, %)	12 (60%)	17(85%)	18(90%)
Female (n, %)	08 (40%)	03(15%)	02(10%)
Age (years)	48.1± 10.76	46.95±08.70	46.85±08. 73
Height (cm)	157.86± 08.16	160.52±08.38	161.79±09 .50
Weight (Kg)	62.7±10.90	63.2±11.3	64.4± 10.9

Table I. Baseline characteristics of the Subjects

Group	Blood Sugar(Initial)	Blood Sugar(After 8 weeks)
Gr.1(T2DM+ Sedentary lifestyle)	**127.02±18.76**	**129.54±20.02**
Gr.2(T2DM+ Physical activity)	**118.11±13.06**	***104.10±08.66 p <.001**
Gr.3(T2DM+ Physical activity+ No Coffee)	**117.90±11.96**	**117.54±10.66**

Table II. Impact of moderate Bunna consumption (6-8 cups/day) for 8 weeks on fasting blood glucose level among T2DM subjects.(Data expressed in mg/ dl are Mean±SD of N=20)

5. Conclusion

Besides caffeine, coffee contains numerous compounds like phenols, diterpenes, trigonelline, cholorogenic acid, magnesim which affect glucose metabolism & help to improve condition of T2DM and is activated by physical activity.

REFERENCES

[1] M.S. Butt and M.T. Sultan, "Coffee and its consumption: Benefits and Risks," Critical Reviews in food Science and Nutrition, vol. AP-51, pp. 363-373, 2011.

[2] N.S. Prakash, M.C. Combes, N. Somanna and P. Lashermes, "AFLP analysis of introgression in coffee cultivars.(Coffea Arabica L). derived from a natural interspecific hybrid," Euphytica, vol 124, pp. 265- 271,2002.

[3] R.J. Clarke and O.G. Vitzthum, Coffee: Recent Developments. Blackwell Science, Berlin.

[4] K.C. Willson, Coffee, Cocoa and Tea. CABI Publishing, UK.

[5] L.C. Trugo, Analysis of coffee products in Encyclopedia of Food Sciences and Nutrition. Academic Press- Elsevier Science, London, UK.

[6] D.V. Rodriguez de Sotillo, and M. Hadley, "Chlorogenic acid modifies plasma and liver concentrations of cholesterol, triacylglycerol and minerals in (fa/fa) Zucker rats," J Nutr Biochem, vol 13, No 12, pp. 717- 726, 2002.

[7] R.M. Van Dam, "Coffee and type 2 diabetes: from beans to beta cells," Nutr Metab Cardiovas Dis, vol 16, No 1, pp. 69- 77, 2006.

[8] J. Shearer, E.A. Sellars, A. Farah, T.E. Graham, D.H. Wasserman, "Effects of chronic coffee consumption on glucose kinetics in the conscious rat," Can J Physiol Pharmacol, vol 85, No 8, pp. 823- 830, 2007.

[9] R. M. Van Dam and F. B.Hu, "Coffee consumption and risk of type 2 diabetes: a systematic review," Journal of the American Medical Association, vol. 294, no. 1, pp. 97–104, 2005.

[10] R. Huxley, C. M. Y. Lee, F. Barzi et al., "Coffee, decaffeinated coffee, and tea consumption in relation to incident type 2 diabetes mellitus: a sytematic review with meta-analysis," Archives of Internal Medicine, vol 169, no 22, pp. 2053- 2063, 2009.

[11] E. Salazar-Martinez, W. C. Willett, A. Ascherio et al., "Coffee consumption and risk for type 2 diabetes mellitus," Annals of Internal Medicine, vol. 140, no. 1, pp. 1–8, 2004.

[12] R. M. Van Dam, W. C. Willett, J. E. Manson, and F.B. Hu, "Coffee, caffeine, and risk of type 2 diabetes: a prospective cohort study in younger and middle-aged U.S. women," Diabetes Care, vol. 29, no. 2, pp.398–403, 2006.

[13] M. A. Pereira, E. D. Parker, and A. R. Folsom, "Coffee consumption and risk of type 2 diabetes mellitus: an 11-year prospective study of 28 812 Post menopausal women," Archives of Internal Medicine, vol. 166, no. 12, pp. 1311–1316, 2006.

[14] T. E. Graham, P. Sathasivam, M. Rowland, N.Marko, F.Greer, and D. Battram, "Caffeine ingestion elevates plasma insulin response in humans during an oral glucose tolerance test," Canadian Journal of Physiology and Pharmacology, vol. 79, no. 7, pp.559–565, 2001.

[15] L. E. Robinson, S. Savani, D. S. Battram, D. H. McLaren, P. Sathasivam, and T. E. Graham,"Caffeine ingestion before an oral glucose tolerance test impairs blood glucose management in men with type 2 diabetes," Journal of Nutrition, vol. 134, no. 10, pp. 2528–2533, 2004.

[16] H. J. Petrie, S. E. Chown, L. M. Belfie et al.,"Caffeine ingestion increases the insulin response to an oral-glucose-tolerance test in obese men before and after weight loss," American Journal of Clinical Nutrition, vol. 80, no. 1, pp. 22–28, 2004.

[17] D. S. Battram, R. Arthur, A. Weekes, and T. E. Graham, "The glucose intolerance induced by caffeinated coffee ingestion is less pronounced than that due to alkaloid caffeine in men," Journal of Nutrition, vol. 136, no. 5, pp. 1276–1280, 2006.

[18] L. L. Moisey, S. Kacker, A. C. Bickerton, L. E. Robinson, and T. E. Graham, "Caffeinated coffee Consumption impairs blood glucose homeostasis in response to high and low glycemic index meals in healthy men," American Journal of Clinical Nutrition, vol. 87, no. 5, pp. 1254–1261, 2008.

[19] National Institute of Health. National Institute of Diabetes and Digestive and Kidney Disease. National Diabetes Statistics, 2007 fact sheet. 2008. http://diabetes.niddk.nih.gov/DM/PUBS/statistics

[20] International Diabetes Federation. The Diabetes Atlas, third edition. 2006. http://www.eatlas.idf.org/media/

[21] WHO Global Report. Preventing Chronic Diseases:A Vital Investment , WHO: Geneva,Switzerland,2011.http://www.who.int/chp/chronic_disease_report.

[22] Kao WH, Folsom AR, Nieto FJ, Mo JP, Watson RL,Brancati FL. "Serum and dietary magnesiumand the risk for type 2 diabetes mellitus: the Atherosclerosis Risk in Communities Study," Arch Intern Med, vol 159, pp. 2151–2159,1999.

[23] Lopez-Ridaura R, Willett WC, Rimm EB, Liu S, Stampfer MJ, Manson JE, et al. "Magnesium intake and risk of type 2 diabetes in men and women,"Diabetes Care, vol 27, pp. 134–140, 2004.

[24] Van Dam RM, Hu FB. "Coffee consumption and Risk of type 2 diabetes: a systematic review,"JAMA, vol 294, pp. 97–104,2005.

[25] Van Dam RM, Willett WC, Manson JE, Hu FB. "Coffee, caffeine, and risk of type 2 diabetes: a Prospective cohort study in younger and middle-aged U.S. women," Diabetes Care, vol 29, pp. 398–403, 2006.

[26] Van Dam RM. "Coffee consumption and the decreased risk of diabetes mellitus type 2," Ned Tijdschr Geneeskd, vol 150, pp. 1821–1825,2006.

[27] Kempf K, Herder C, Erlund I, Kolb H, Martin S, Carstensen M, et al. "Effects of coffee consumption on subclinical inflammation and other risk factors for type 2 diabetes: a clinical trial," Am J Clin Nutr, vol 91, pp. 950–957,2010.

[28] Arion WJ, Canfield WK, Ramos FC, Schindler PW,Burger HJ, et al. "Chlorogenic acid and hydroxynitrobenzaldehyde: New inhibitors of hepatic glucose 6-phosphatase," Archives of Biochemistry and Biophysics, vol 339, pp. 315–322, 1997.

[29] McCarty MF, "A chlorogenic acid-induced increase in GLP-1 production may mediate the impact of heavy coffee consumption on diabetes risk," Medical Hypotheses, vol 64, pp.848–853,2005.

[30] Bassoli BK, Cassolla P, Borba-Murad GR, Constantin J, Salgueiro- Pagadigorria CL, et al.," Chlorogenic acid reduces the plasma glucose peak in the oral glucose tolerance test: Effects on hepatic glucose release and glycaemia," Cell Biochemistry and Function, vol 26, pp. 320–328,2008.

[31] Hemmerle H, Burger HJ, Below P, Schubert G, Rippel R, et al. "Chlorogenic acid and synthetic chlorogenic acid derivatives: Novel inhibitors of hepatic glucose-6-phosphate translocase," Journal of Medicinal Chemistry, vol 40, pp.137–145,1997.

[32] Ong KW, Hsu A, Tan BKH, " Chlorogenic Acid Stimulates Glucose Transport in Skeletal Muscle via AMPK Activation: A Contributor to the Beneficial Effects of Coffee on Diabetes," PLoS ONE,vol 7 no3, pp. 1-10, 2012.

[33] Kahn BB, Alquier T, Carling D, Hardie DG, "AMP-activated protein kinase: Ancient energy gauge provides clues to modern understanding of metabolism,"CellMetabolism,vol.1, pp.1525,2005.

[34] Kurth-Kraczek EJ, Hirshman MF, Goodyear LJ, Winder WW, "AMP activated protein kinase activation causes GLUT4 translocation in skeletal muscle. Diabetes, vol 48, pp.1667–167.